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Subject: RECOMMENDED PRACTICES AND PROCEDURES FOR THE USE OF ELECTRONIC LONG-RANGE NAVIGATION EQUIPMENT

1. PURPOSE. This advisory circular presents recommended operational practices and procedures for the use of electronic long-range navigation equipment in oceanic or remote land areas.

2. RELATED FAR SECTIONS. FAR 91.1(b), 91.20, 91.75, 91.123, Appendix C of 91, 121.103, 121.355, 121.389, Appendix G of 121, 123.27, and 135.2.

3. RELATED READING MATERIAL. Appendix 1 contains a list of related publications and information on how they may be obtained.

4. BACKGROUND.

a. Recently, many domestic operators have received Civil Aeronautics Board (CAB) Economic Authority to operate over international routes. Additionally, the standards for navigation have been upgraded in a large portion of the airspace over the North Atlantic to accommodate the increasing air traffic. Similar standards are under consideration for some airspace over the Pacific. New navigation equipment is presently being introduced into the aviation community to meet these requirements and to serve as a replacement for Loran A which is scheduled for a phased shutdown through 1980. These factors, as well as others, indicate that effective navigation practices and procedures must be applied by all operators to ensure that a high level of safety is maintained. The recommended operational practices and procedures presented in this advisory circular have proven to be an effective means of attaining successful navigation.

b. It is recognized that many methods of navigation exist, and that various types of electronic navigation equipment are available. However, the general trend of equipment development and user choice has been toward automated equipment. This circular will address three of the most commonly used types of long-range navigation equipment: Doppler, with update means, Inertial Navigation System (INS) and Omega. Some procedures or practices are applicable to all three types of equipment. These common recommended procedures are presented first, followed by recommended practices and procedures unique to each of the three types of equipment. Recommended practices and procedures are also presented for the resolution of various navigational difficulties.

5. DEFINITIONS. For the purposes of this advisory circular, the following definitions apply:

a. Gateway. A specific navigation fix where a flight transitions from short-range (airways) navigation to long-range (oceanic) navigation or vice versa. Such fixes ordinarily are airways navigation facilities (VOR, NDB, etc.) located at or near oceanic airspace entry/exit points.

b. Long-Range Navigation. Flight operations outside (beyond) the published service volume (range) of short-range (airways) navigation facilities (i.e., VOR, VOR/DME, NDB).

c. Dead Reckoning (DR). A method of directing an aircraft and estimating its position by the application of time, direction and speed data to a previously determined position.

d. Cross-Check. This is a term for methods used to carefully monitor and verify navigation information so as to ensure compliance with a currently effective Air Traffic Control (ATC) clearance. The keystone of successful navigation is effective cross checking procedures. In order to minimize the exposure to human error, each manual insertion of input data into the navigation system should be carried out in its entirety by one crewmember and then recalled and verified by another. Cross checking procedures should include:

(1) Verification that all data inserted into the system is correct;

(2) Verification that the systems are operating properly;

(3) Confirmation that system controls and switches are properly configured to provide the desired information; and

(4) Frequent confirmation of navigation performance to ensure that the ATC assigned track is maintained and that the

information presented by the systems remains reasonable.

e. Waypoint. A geographic point specified for navigation, flight planning or air traffic control purposes. For automated navigation systems (i.e., INS, Omega), a waypoint is usually inserted as latitude and longitude coordinates. For semi-automated navigation systems (i.e., Doppler), a waypoint is usually inserted as a bearing and distance from a previous position.

6. GENERAL NAVIGATION PRACTICES AND PROCEDURES. Experience indicates that the increased accuracy and reliability of modern automatic navigation systems can induce a degree of complacency in the operator which may result in the failure to routinely cross check system performance. Under these circumstances, human errors may remain undetected for excessive periods. Although navigation errors are infrequent occurrences, human errors have accounted for a majority of the errors attributed to aircraft equipped with automated systems. Most inadvertent navigation errors have occurred when the equipment was functioning normally. The operating procedures prescribed were either inadequate or were not followed. A common error associated with automated systems is incorrect programing of the oceanic waypoint latitudes by multiples of one degree (60 nautical miles (nm)). In an organized track system, this can result in the flight maintaining a wrong track with high precision and thereby constituting a serious threat to other aircraft properly occupying that track and flight level. Vigilance and diligence in properly applying established procedures are essential ingredients of safe oceanic navigation. Although operational procedures (checklists) may differ slightly between specific navigation systems, many good practices and procedures are basic to all automated and semiautomated systems. These basic practices and procedures are presented in this paragraph.

a. Preflight Planning. One of the basic fundamentals of good navigation is prior planning. Aside from planning to ensure successful navigation under normal circumstances, the successful resolution of many in-flight navigation difficulties depends to a large degree on thorough preflight planning. Some of the more important factors are addressed below:

(1) The Navigation Flight Plan. Since many operators use a computerized navigation flight plan, this planning task has been greatly simplified. However, care should be taken to verify that all en route waypoints are correctly and legibly shown on the flight plan. Also, it is desirable to select a waypoint loading sequence and number each waypoint accordingly. If more than one copy of the flight plan is to be used by various crewmembers, designate one as the official copy. To eliminate possible confusion, ensure that all necessary information (i.e., routing changes, estimated times of arrival, waypoint loading sequence) is recorded on this flight plan and this copy is used for all reports to ATC. Additionally, if the flight is within the North Atlantic Organized Track Structure (OTS), obtain a copy of the current track message (ATC expects the flightcrew to have a copy) and be alert for a conflict between the flight plan and

the track message. Track messages are issued periodically and describe the North Atlantic routes, gateways and flight levels available for eastbound and westbound flights during the period indicated in the message (usually 12 hours).

(2) Weather. In addition to the normal review of weather information concerning terminals, be alert for hazardous weather en route which may require a flight plan change or in-flight rerouting. It is important to obtain a copy of the wind flow chart (constant pressure chart or equivalent) for your flight level and route since this information may prove valuable when evaluating wind forecasting "errors" and if DR operation should be necessary due to equipment failure. It is desirable to plot the route of flight on the chart to increase its usefulness. Also, as the flight progresses, consideration should be given to plotting actual wind information on the chart as a means of evaluating the accuracy of the forecast.

(3) NOTAMS. Besides checking Notices to Airmen (NOTAMS) for facilities at departure, destination and alternate airports, NOTAMS concerning navigation aids or special airspace restrictions along the planned route of flight should be checked. Omega users should obtain NOTAMS concerning Omega station operational status to ensure that the required stations are in service. The Airman's Information Manual (AIM) contains additional instructions for obtaining information concerning Omega.

(4) Equipment Preflight.

(i) In addition to operating procedures (checklists) to confirm proper system operation, care should be taken to ensure that the navigation equipment is properly programed. This is a very important procedure which should not be rushed. All navigation information (coordinates or courses and distances) should be programed by one flight crewmember and verified for correctness by another. Also, verify that the same waypoint loading sequence is used for each system. At this time, it is desirable to indicate on the flight plan that the present position (if applicable) and waypoints have been entered and crosschecked. If time becomes a factor, it is more important to verify that the first 2 or 3 waypoints are correct than to rush through the procedures to "insert" as much information as possible. Consideration should be given to using another cross-check which compares the flight plan or charted distance between waypoints and the distance computed by the navigation system to detect programing or flight planning errors. This serves as a double check on waypoint verification and will also reveal an error in the flight plan should one exist. A difference in distance of more than + or - 2 nm may indicate a programing or flight planning error.

(ii) It is advisable not to transcribe waypoint coordinates from source documents (track message, en route charts, etc.) onto the flight plan for insertion into the navigation computers. In order to avoid errors in transcription, waypoint coordinates should be inserted into the computers directly from the source documents.

(iii) Since the initial stages of the flight can be very busy, consideration should be given to ensuring the navigation system waypoint transfer switches are placed in "auto" to facilitate outbound tracking and waypoint changeover during this period.

(iv) With systems such as INS or Omega, which navigate during ground operation, it is advisable to cross check present position, taxi distance or groundspeed, as appropriate, prior to takeoff to confirm proper system operation and to ensure that the present position remains reasonable.

b. En Route - Within Range of the Outbound Gateway. Flights should not continue beyond the outbound gateway unless the required long-range navigation equipment is functioning properly. To confirm proper operation, certain cross-checks should be performed while within range of the gateway navigation aid. Since this may be the last positive position cross-check until the inbound gateway, the following practices may also provide valuable information for resolving any later navigation difficulties:

(1) ATC Clearance. All ATC oceanic clearances should be cross checked by two crewmembers to ensure the clearance is copied correctly. Any flight plan waypoints which may have been revised in an ATC clearance should be crossed out and the revised coordinates entered in a legible manner. Prior to proceeding outbound from the gateway, the currently effective ATC clearance should be compared to the flight plan and the information in the navigation computers for the gateway and the subsequent waypoints should be verified.

(2) Gross Error Check. A gross error check is a position accuracy cross-check, using normal airway facilities such as VOR, VOR/DME or NDB. The gross error check is usually accomplished by flying directly over the gateway (if possible) and subsequently establishing the aircraft on the outbound course using the gateway navigation aid. This check serves the following purposes:

(i) Detects errors which may have accrued in position information since takeoff.

(ii) Provides information which can be used to determine which system is most accurate for use as a steering reference.

(iii) Provides an opportunity to correct position information, if necessary.

(iv) Can be used to confirm that the aircraft is established on the outbound course and is tracking toward the next waypoint.

(v) Can be used to confirm that the aircraft is proceeding via the currently effective ATC clearance.

(3) "Radio/Nav" Switches. In cases where flight instruments are used for the display of either airways (VOR) information or information from the long-range navigation system, the "Radio/Nav" switches should be left in the "Radio" position after passing overhead the gateway navigation aid until the radio information begins to become degraded. The switches should then be placed in the "NAV" position.

(4) Compass Deviation Check. Consideration should be given to performing a compass deviation check on systems, such as INS, which use true heading information from sources independent of the aircraft compass system. The compass deviations can be determined by comparing the INS derived magnetic heading to each compass heading. This information may be used later in the flight to determine the most accurate system should a divergence between systems occur. The compass deviations can be applied to the respective compasses to determine the actual magnetic heading. Local variation can be applied to the true heading of each INS to obtain the derived magnetic headings. The most accurate INS should be the one with a magnetic heading which compares favorably with the actual magnetic heading.

c. En Route - After Passing the Gateway. The following practices should be used to monitor flight progress and confirm that the assigned route of flight is maintained:

(1) The system determined to be most accurate during the gross error check should usually be selected as the autopilot steering reference.

(2) Whenever possible, the system designated as a steering reference should routinely display present position information.

(3) Another system should be selected to routinely indicate crosstrack (XTK) information.

(4) Crosstrack (XTK), distance to go (DIS), and track angle error (TKE), if available, should be periodically cross checked to confirm that track centerline is maintained.

d. En Route - Approaching Each Waypoint. When within approximately two minutes of each waypoint, the following practices should be used:

(1) Both pilots should verify that the subsequent waypoint in the navigation displays agrees with the currently effective ATC clearance.

(2) Position information on the navigation displays should be recorded and compared with the currently effective ATC clearance in order to ensure that the aircraft is where it is supposed to be.

e. En Route - After Passing Each Waypoint. Within several minutes after passing each waypoint, the following practices should be used:

(1) Confirm that the navigation systems have switched to the next flight segment (leg change).

(2) Confirm that the aircraft is tracking along the next flight segment (tracking outbound).

(3) Approximately 10 minutes after passing each waypoint, the present position information on the navigation displays should be plotted on a navigation chart to confirm that the ATC clearance is satisfied (not applicable to most Doppler systems).

f. En Route - Approaching the Inbound Gateway. Certain preparations should be made for the transition from long-range navigation to airways navigation. The following practices are recommended:

(1) As soon as feasible, set up the navigation radios to receive the inbound gateway navigation aid.

(2) When the gateway navigation aid is providing reliable information, place the "Radio/Nav" switch in the "Radio" position and steer the aircraft so as to acquire and maintain the proper inbound radial/bearing.

(3) Unless directed otherwise by ATC, the aircraft should be flown directly overhead the gateway.

(4) When overhead the gateway, record the position information from the navigation displays. This information can be used to confirm system accuracy. It is recommended that system accuracy computations be made after arrival to avoid conflicts with other cockpit duties during the critical periods of descent, approach and landing.

g. After Arrival. The individual navigation system errors and error rates, if applicable, should be computed and recorded for future reference. It is desirable to record this information in a document which remains aboard the aircraft to provide subsequent flightcrews with a recent history of system performance. This information may be used with most systems to predict individual system performance for future flights under similar circumstances. Additionally, this information may prove valuable to subsequent flightcrews for resolving navigation abnormalities, such as a divergence between systems.

7. SPECIAL PRACTICES AND PROCEDURES - DOPPLER. In addition to the general practices and procedures contained in paragraph 6, the following information applies to Doppler navigation systems. Since a Doppler system (sensor plus computer) is a semi-automatic dead reckoning device which is less accurate than an INS or Omega system, a means of updating the Doppler is usually required if acceptable position accuracy is to be achieved on long-range flights. INS, Omega or LORAN C may be used as the updating

reference for the Doppler system. The following factors should be considered when using Doppler navigation systems:

a. Compass Accuracy. Most Doppler systems measure groundspeed to an accuracy of about one percent and drift angle to a fraction of a degree. Its directional reference, however, is the aircraft's compass system. If the overall Doppler/compass system is to be usefully accurate, the compass should be swung and compensated so that its error does not exceed one degree on any heading.

b. Preflight.

(1) During preflight, the flight plan courses and distances for those flight segments where Doppler navigation is required should be verified. Normally, the courses should be determined to the nearest one tenth of a degree and the distances to the nearest nautical mile. This is routinely accomplished by using course and distance tables designed for this purpose. Care and accuracy are important factors during this cross-check.

(2) If the Doppler system is to be used for navigation from takeoff, both "A" and "B" stages should be programed and the "auto/manual" switch should be placed in "auto." Also, the proper position for the "land/sea" switch should be determined since this affects the accuracy of the groundspeed information.

c. When Approaching the Outbound Gateway.

(1) The Doppler system performance records for recent flights over similar routes should be reviewed to determine if a system deviation correction should be applied. If the records indicate that a deviation correction may be necessary, apply the corrections to the Doppler systems used.

(2) Both pilots should verify that the outbound course and distance programed in the active stage conforms to the currently effective ATC clearance.

(3) Unless required otherwise by ATC, the aircraft should be flown directly overhead the gateway fix to obtain the most accurate starting position practicable. When directly overhead the gateway, both pilots should ensure that the Doppler computers have been activated and that the proper stage is selected.

(4) The aircraft should be established on the outbound track by using the gateway navigation aid. Once this is accomplished, the gross error cross-checks discussed in paragraph 6 should be accomplished.

(5) Consideration should be given to using an additional cross-check. This is accomplished by applying drift angle to compass heading and comparing the result (actual track) to the flight planned magnetic course.

d. Updating the Doppler Computer.

(1) Since Doppler systems (in the magnetically slaved mode) fly a "rhumb line" (curved) track and most navigation charts commonly used reflect "great circle" (straight) tracks, certain precautions should be observed when updating Doppler systems. Although a great circle course and a rhumb line course begin and end at common points, a divergence between the two courses exists between the waypoints. This divergence normally reaches a maximum near the midpoint of the leg and the magnitude of the divergence increases as the latitude and the distance between waypoints increases.

(2) Under normal circumstances, position fixes for Doppler update purposes should be obtained within 75 nm of a waypoint to minimize the possibility of inducing an error into the Doppler system due to the "rhumb line" effect. This practice should be applied to both manually obtained and automatically obtained position fixes.

(3) When Doppler systems are used in the grid (free gyro) mode, the Doppler track will approximate a "great circle" and "rhumb line" effect is not a factor. Under these conditions, the updating restrictions previously detailed are not normally applicable.

8. SPECIAL PRACTICES AND PROCEDURES - INS. In addition to the general practices and procedures in paragraph 6, the following recommendations apply specifically to INS:

a. Preflight.

(1) Since INS is a dead reckoning device and not a position fixing device, any error induced during alignment will be retained and possibly incremented throughout the flight unless removed through updating procedures. Therefore, during preflight, care should be exercised to ensure that accurate present position information is "inserted" into the INS. Although most INS will automatically detect large errors in present position latitude during alignment, large errors in present position longitude may exist without activating a warning indication. Therefore, when cross checking present position coordinates, be alert for the correct hemispheric indicator (i.e., N, S, E, W) as well as the correct numerical values. Since most INS cannot be realigned in flight, special procedures, such as ground realignment, may be required to correct a significant error in present position. If the INS in use have the capability of "gang-loading" (simultaneous loading) by use of a remote feature, care should be taken so that any data entered by this method is cross checked separately on each individual INS to detect data insertion errors.

(2) The INS software identification and modification status codes should be verified to ensure that the proper equipment is installed and the appropriate operating checklist is used.

(3) The operating checklists should include a means of

ensuring that the INS are ready to navigate and that the navigation mode is activated prior to moving the aircraft. Any movement of the aircraft prior to activating the navigation mode may induce very large errors which can only be corrected by ground realignment.

(4) After the system is placed in the navigation mode, the INS groundspeed should be checked when the aircraft is stationary. An erroneous reading of more than a few knots may indicate a faulty or less reliable unit. If this occurs, a check should be made of the malfunction codes.

b. In-Flight Updating. Since INS are essentially accurate and reliable, there is the possibility that in an attempt to obtain a slight improvement in accuracy by in-flight updating, a human mistake may result in a more serious error. On the other hand, INS errors generally increase with time and are not self-correcting. Therefore, if large tracking errors are permitted to occur, aircraft safety and separation criteria may be significantly degraded. The aforementioned factors should be considered in any decision relative to in-flight updating. As a guide to flightcrews, some operators consider that unless the ground facility provides a precise check, and unless the error is fairly significant (e.g., more than 6 nm or 2 nm/hr), it is preferable to retain the error rather than update.

9. SPECIAL PRACTICES AND PROCEDURES - OMEGA.

a. Since the control/display units (CDUs) of most Omega systems are similar in appearance to those used for INS, persons familiar with INS may have a tendency to assume that Omega has similar performance characteristics. This assumption could create significant problems. INS is a precision dead reckoning (DR) device which is wholly self-contained within the aircraft and has a nominal position degradation of about one mile per hour of flight. Omega, in contrast, continuously resolves aircraft position by processing radio signals received from a global network of transmitters. It is therefore possible for Omega to be affected by signal propagation disturbances and abnormally high local radio noise levels.

b. In normal operation, Omega provides a position accuracy of 1 to 3 miles which, unlike INS, does not degrade with increasing flight time. However, most Omega systems compute position in signal "lanes" which are a function of the signal wavelength. A disturbance of sufficient magnitude may force the computed position into an adjacent "lane" and thereby cause an error which is measured in multiples of the basic "lane" width. This occurrence is termed a "lane slip." Most Omega systems possess an auxiliary operating mode termed "Lane Ambiguity Resolution" (LAR). The purpose of this mode is to correct the "lane slip" by returning the present position to the correct "lane". A more detailed description of OMEGA lane ambiguity is provided in ICAO Circular 139 - AN/95, Aviation Use of OMEGA.

c. Whereas INS position errors normally accrue gradually with elapsed flight time, most Omega errors occur suddenly and are usually multiples of the basic lane width. Effective cross checking procedures should be accomplished at regular intervals and LAR or inflight updating should be initiated when the position accuracy is in doubt. In addition to the general practices and procedures contained in paragraph 6, the following recommendations apply to Omega systems:

(1) Preflight.

(i) Be alert for any NOTAMS affecting the operational status of the individual Omega transmitters; particularly for possible abnormal operation. Deselection of any station reported to be in abnormal operation should be considered at the onset of the flight. Also be alert for any NOTAMS relating to propagation disturbances, such as Sudden Ionospheric Disturbances, Sudden Phase Anomalies, or Polar Cap Anomalies, which may affect Omega positioning accuracy. Scheduled Omega status broadcasts on station WWV should be monitored as a means of obtaining current Omega information.

(ii) The OMEGA software and modification status codes should be verified to ensure that the proper equipment is installed and that the appropriate operating checklist is used.

(iii) At certain ground locations, particularly at congested terminals, abnormally high radio noise levels may adversely affect the Omega. For example, synchronization may take longer than normal or the inserted ramp coordinates may drift after insertion. Synchronization or DR warning lights usually indicate this situation. This problem normally disappears, if the Omega equipment is serviceable, shortly after the switch to aircraft power or after the aircraft is moved from the gate. Care should be exercised during taxi, since abrupt turns may cause a momentary loss of signals which could affect system accuracy. It is good practice to cross check present position coordinates or taxi distance before takeoff to detect any errors which may have occurred since initialization.

(2) In-Flight Updating. The same considerations basic to updating an INS also apply to Omega due to the normal accuracy and reliability of these systems. However, in addition to the capability to update overhead a navigation aid, most Omega systems are capable of performing a LAR if certain signal strength and station geometry requirements are met. Unless an apparent Omega error exceeds approximately 6 nm, a lane slip may not necessarily have occurred and LAR or updating is not normally recommended. If an LAR appears to be necessary, the LAR should be initiated on only one system at a time so that the other system remains unaffected for use as a cross-check. The LAR should be attempted first on the system believed to be the least accurate.

10. NAVIGATION DIFFICULTIES. Although the accuracy and reliability of the newer automated navigation systems are excellent, malfunctions and failures occasionally occur. When a malfunction occurs, crews should guard against jumping to conclusions since hasty actions are seldom necessary and may

further complicate the situation. Experience has shown that successful resolution of navigation difficulties in oceanic areas usually requires a thorough, thoughtful process which normally begins during preflight planning. The following guidance is presented for consideration when navigation difficulties are encountered or suspected:

a. Detection of System Failures. In general, system failure is usually considered to have occurred when one or more of the following situations develop:

(1) A warning indicator is activated which cannot be reset.

(2) Self-diagnostic or built-in test equipment (BITE) indicates that the system is unreliable.

(3) The position error overhead a known geographic position exceeds the maximum permissible tolerance established for a particular navigation system.

(4) The system operation is so abnormal, despite the absence of warning or malfunction indications, that the crew considers the system no longer useful for navigation.

b. Detection of System Degradations or Malfunctions. While system failures are usually straightforward, malfunctions or gradual system degradations usually are more difficult to resolve. This is particularly true when only two systems are on board. Navigation difficulties of this type are usually detected by a divergence between the navigation systems which often occurs gradually. This factor may reduce the possibility of identifying the faulty system unless periodic cross-checking practices are diligently used. The following factors should be considered when attempting to identify a faulty system:

(1) Check the malfunction (BITE) codes for indications of system fault.

(2) For Omega, the system receiving the most stations and the best quality signals should generally be the most accurate.

(3) Review the gateway gross error check for indications of the most accurate system.

(4) If a regular record of system performance has been maintained and is available, a review of the record may give a clue as to which system is faulty.

(5) If possible, use VOR, ADF, DR, airborne radar, or other navigation aids to obtain a position fix.

(6) Cross-check heading, groundspeed, track and wind information between systems and compare to best known information.

(7) Attempt to contact nearby aircraft to obtain wind or groundspeed and drift information which may identify the malfunctioning system.

(8) The compass deviation check discussed in paragraph 6b(4) may provide a clue as to which system is faulty for systems such as INS.

NOTE: Even though these steps are taken, the occasion may still arise where a divergence between systems is observed, but the crew cannot determine which system is at fault. When this occurs, the practices in paragraph 10d should be used.

c. Recommended Actions Following System Failure. After a system malfunction or failure has been detected, ATC should be informed that the flight is experiencing navigation difficulties so that separation criteria can be adjusted, if necessary. Reporting malfunctions to ATC is an ICAO requirement and compliance is required by FAR Part 91. If the failed system can be identified with a high degree of confidence and the other system appears normal, the best course of action may be to fly the normal system and carefully monitor its performance using any additional navigation aids available, including DR. In the unlikely event that a total navigation failure occurs and other aids are unavailable, the only action may be to dead reckon using the flight plan headings and times. Under these circumstances, continue to use all means available to obtain and use as much navigational information as possible. Be alert for visual sightings of other aircraft since a potential hazard may exist due to inadvertent deviation from your assigned track. Also, in some cases, it may be possible to establish and maintain visual contact with another aircraft on the same track.

d. Recommended Actions Following a Divergence Between Systems. Since a small divergence between systems may be normal, the significance of the divergence should be evaluated. In general terms, if the divergence is less than 10 nm, the best course of action may be to closely monitor system performance and continue to steer the system considered most accurate. If the divergence between systems is greater than 10 nm, one of the systems may be degraded. Therefore, attempts should be made to determine which system may be faulty. If the faulty system cannot be determined using the practices in paragraph 10b and both systems appear normal, the action most likely to limit gross tracking errors may be to position the aircraft so that the actual track is midway between the crosstrack differences for as long as the position uncertainty exists. ATC should be advised that navigation difficulties are being experienced so that separation criteria may be adjusted as necessary. Consideration should be given to abandoning this "split-the-difference" practice if the divergence exceeds the separation criteria currently in effect. If a divergence of this magnitude occurs and the faulty system cannot be isolated, the best course of action may be to DR using the best known wind information. In some cases, the best known information may be flight plan headings and times.

/s/ KENNETH S. HUNT
Director of Flight Operations

APPENDIX 1. RELATED READING MATERIAL

Additional information concerning navigation practices, procedures and equipment may be found in the following documents:

1. Federal Aviation Administration (FAA) Advisory Circulars.

a. Advisory Circular 90-76, Flight Operations in Oceanic Airspace.

b. Advisory Circular 91-49, General Aviation Procedures for Flight in North Atlantic Minimum Navigation Performance Specifications Airspace.

c. Advisory Circular 120-31A, Operational and Airworthiness Approval of Airborne Omega Radio Navigation Systems as a Means of Updating Self-Contained Navigation Systems.

d. Advisory Circular 120-33, Operational Approval of Airborne Long-Range Navigation Systems for Flight Within the North Atlantic Minimum Navigation Performance Specifications Airspace.

e. Advisory Circular 120-37, Operational and Airworthiness Approval of Airborne Omega Radio Navigation Systems as a Sole Means of Overwater Long Range Navigation.

f. Advisory Circular 121-13, Self-Contained Navigation Systems (Long Range).

Copies of these documents may be obtained free of charge from the U.S. Department of Transportation, Publications Section M 443.1, Washington, D.C. 20590.

2. Other Federal Aviation Administration Documents.

a. Airman's Information Manual, Basic Flight Information and ATC Procedures.

b. International Flight Information Manual.

c. International Notices to Airmen.

Copies of these documents may be obtained on a subscription basis from the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402.

3. International Civil Aviation Organization (ICAO) Documents.

a. Annex 2 to the Convention on International Civil Aviation -- Rules of the Air.

b. Procedures for Air Navigation Services -- Rules of the Air and Air Traffic Services (Doc. 4444-RAC/501).

c. Regional Supplementary Procedures (Doc. 7030/2).

d. Aviation Use of Omega (Circular 139-An/95).

Copies of these documents may be purchased from the International Civil Aviation Organization (attn: Distribution Officer), P.O. Box 400, Succursale: Place de I'Aviation Internationale, 1000 Sherbrooke Street West, Montreal, Quebec, Canada H3A 2R2.

4. Guidance and Information Material Concerning Air Navigation in the NAT Region, T 13/5N-854.

Copies of this document may be obtained from the International Civil Aviation Organization, European Office, 3 Bis, Villa Emile Bergerat, 92200 - Neuilly-Sur-Seine, France.